THURSDAY, FEBRUARY 3, 1876

THE UNIVERSITY OF LONDON AND SCHOOL EXAMINATIONS

EXAMINATIONS, like fire and many other useful things within their proper limits, are good servants, but very tyrannous masters. It is excellent that knowledge should be tested; that men—and shall we say women—shall be found out for their souls' good if they innocently deceive themselves as to their acquirements, for the sake of the community if they assume knowledge they really do not possess. Unfortunately, what was once a means bids fair to become an end; and it is quite certain that a great deal of knowledge is acquired nowadays which finds its only use within the walls of the examination room. It is perhaps a law of human nature that those who have bitterly endured the harrow—not to suggest metaphorically another implement—are ever afterwards eager that all mankind should endure the same process with no feature of its asperity mitigated. In the Report of the Sub-committee of the Annual Committee of the Convocation of the University of London on the Examination and Inspection of Schools, this feeling makes itself curiously apparent :—

"The Universities of Oxford and Cambridge having for many years held local examinations, and having recently initiated a joint scheme, in accordance with which they have examined a progressively increasing number of schools, your Sub-committee fear, that unless this University is prepared to undertake a share in this great work, many schools, which have hitherto acted as feeders to this University, will grow into organic relation with the older Universities, and that, consequently, *the number of candidates for the London examinations will sensibly decrease.*"

The two ancient Universities having, it will be seen, started a system which has affected, most beneficially, the middle-class education of the country, and this system having worked successfully for many years, are now practically extending it to the higher grade schools. The Annual Committee have not a word to say as to the efficiency of the work, although, as we have frequently said in these columns, much is to be objected as to the position given to science in it. It might, then, be conceived, that there was no need for the modern University to do more than to wish the older ones God-speed. But no; there is no salvation in Oxford and little in Cambridge, and that students should from their youth upwards lean to these *almæ matres* and turn away from the *sicca nutrix* of the metropolis—the examining board with all its sternest features unmitigated by the prestige of a professoriate, or the ameliorations of a traditional culture—was a thing not to be endured. The University must be at least true to its principles. When on the eve of the elections of the present Parliament, people were dimly suspecting the beginning of the end of the Liberal administration, Mr. Lowe, addressing his constituents in Convocation, devoted all his powers to the task of portraying the terrible things that must happen if the Conservatives ever came to power. He passed lightly over the disappearance of a surplus—that was too normal a phenomenon with Tories. But he touched a chord on which he knew the response would not be doubtful, when he hinted that possibly the Conservatives might tamper with the principle of competitive examinations; with almost painful earnestness he pleaded hard for mercy as regards that cherished institution. He knew his audience well, and felt that they at least would never neglect the sacred charge, or forget that the true destiny of the human animal, from its youth upwards, is the examination room

It will perhaps be thought that in this matter we have spoken with undue irony, even it may be thought with undue levity. But is it easy to speak with reasonable seriousness of an attitude like that which the Annual Committee has adopted? Surely if the school-examinations were ill-conducted by Oxford and Cambridge the nation would owe the University of London a debt of gratitude if it undertook in good faith to do them better. But there is no evidence that they are ill-done; indeed, there has not been sufficient time to express any comprehensive opinion about them. A good deal is no doubt to be said as to the inadequate place which science holds in these examinations. But for the present the more dignified course for the University of London to adopt—and one which its actual rulers, the Senate, will, it is to be hoped, take into consideration—is to defer any action in this matter till the Oxford and Cambridge system has at least been tried. It is not by entangling schoolboys in its meshes, but by the high standing which is maintained for its superior degrees, that the prestige of Burlington Gardens will be sustained; and in the interests of learning, rather than of examinations, it is to be hoped that grounds of action so cynical will not be again put forward.

GUTHRIE'S "MAGNETISM AND ELECTRICITY"

Magnetism and Electricity. By F. Guthrie, Professor of Physics at the Royal School of Mines. (London and Glasgow: W. Collins, Sons, and Co., 1876.)

DR. GUTHRIE has evidently devoted considerable time and care to the preparation of this text-book. It has undoubtedly a freshness and originality of treatment which, though apt to shock electricians in parts, yet places this treatise in striking contrast to some science class-books of mushroom growth, that bear the mark of scissors and paste on every page. In such books the text too often seems written to illustrate the threadbare woodcuts; here, however, the illustrations are original, and usefully aid the author's meaning. It is true in some cases the cuts are rough and poorly engraved, *e.g.* Figs. 90, 105, 107, 112, 123, 183, and 274, and it is to be regretted that, in the case of instruments at any rate, the illustrations are not drawn to scale but often greatly out of proportion, the reason for which, the author states, is better to show principles; but this hardly applies to apparatus which the student or instrument maker may have to construct from the figures. We like, however, the quaintness seen in many of the terms employed; such as the use of "tandem" to describe cells grouped in simple circuit by "joining the family of zincs to the family of carbons" (p. 183), and the term "abreast," employed to indicate the compound circuit; a source of voltaic electricity is called an "electrogen," and the transport of the products of electrolysis is termed "migration

of the ions," &c. Some of the illustrative analogies given by the author are also very happy, as, for example, the ease with which the molecular transfer is effected in electrolysis is compared to the ease with which a chain hanging over a pulley is moved: "When the two sides are equal each link on one side may be conceived as keeping in equilibrium the opposite link on the other side. A slight force pulling one side down will bring each link opposite to a different one" (p. 137). Incidentally, one or two of the new things strike us as open to question: for instance, the habitual use of the word isolate instead of insulate; the former has a French aspect, and certainly is less familiar to English readers than the latter term. Again,

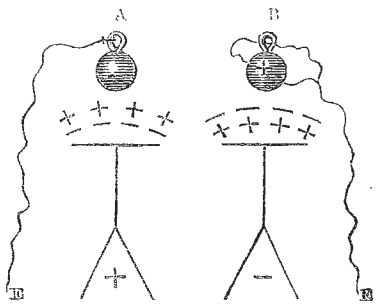

FIG. 1.

the omission of all names of discoverers, because, the author states in the preface, "the book is not a history of discovery;" nevertheless, is it not well that students should be able to associate with Faraday's name, for instance, the famous discoveries he gave to the world? and with all the author's care one or two less important names have crept in, that thus have an undue prominence given to them. On the other hand the unostentatious tone of the book and the entire omission of any reference to the writer, even in the description of the instruments he has devised or the facts he has discovered, are excellent traits, and quite characteristic of the author.

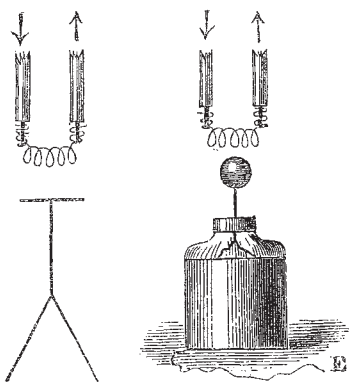

FIG. 2.

The following extracts will illustrate the remarks we have made, and afford our readers an idea of the experimental portion of this treatise. Here is an experiment of the author's which is of considerable interest, whatever explanation may be accepted:—

"When at a bright white heat, an iron ball refuses to receive, or at least to retain, even for a moment, a charge of either + or − electricity. On cooling down, but while still of a red heat, it acquires the power of receiving a − but not a + charge; and this distinction is maintained through a considerable range of temperature. At a lower temperature yet, but still at a dull red heat, the ball begins to be able to receive + electricity, and shortly after, as it cools, it accepts both kinds with nearly equal readiness. . . . Again, if we take two equally-charged gold-leaf electroscopes (Fig. 1), one charged with + and the other with − electricity, and if we bring earth-connected white-hot iron balls a few inches above the caps of each, they will be discharged with nearly the same facility. On repeating the experiment continually, as the balls cool, it is found that A, or the +ly charged electroscope, ceases to be discharged, though the ball is of a red heat, while B, or the − electroscope, continues to be immediately discharged, although the ball has lost all incandescence."

The explanation of this phenomenon Dr. Guthrie takes to be as follows:—"If we conceive the air-bathed and electrically air-straining masses of iron, A and B, to be respectively +ly and −ly electrified, and then to be gradually heated, the air which we have already partly seen to have a greater attachment to + than to − electricity will, supposing the attachment between the metal and both kinds to be equally diminished, succeed first, in the molecular turmoil at the heated surface, in carrying away the +" (p. 81). Hence the apparently opposite effect seen in Fig. 1 is due to the inductive action of the charged electroscope upon the earth-connected ball over-head, so that the ball in A is negatively electrified and retains its charge, whereas in B the ball becomes positively electrified and dissipates its charge as fast as it is renewed, and hence in this case the electroscope is discharged as if by a point. The same power of discharge can be shown by replacing a hot ball with a platinum wire made white hot by a current. Fig. 2 shows an electroscope and a Leyden jar being discharged in this manner.

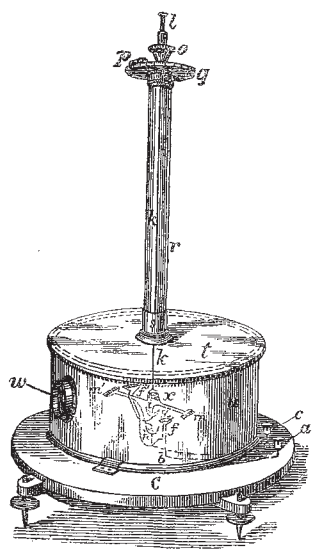

FIG. 3.

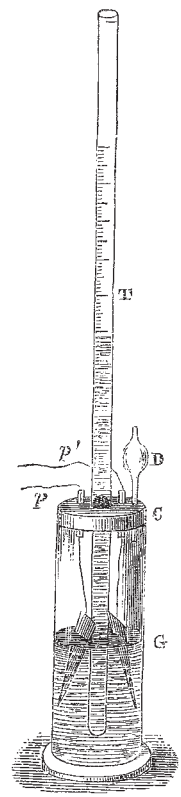

FIG. 4.

Fig. 3 shows an ingenious torsion galvanometer, devised, we believe, by the author, and which is stated to be free from many sources of error.

An ingenious contrivance, due to the author, is shown in Fig. 4. This is a so-called voltastat, an arrangement whereby the current interposes "by its own greater or less action a greater or less resistance in its own circuit," and thus the voltastat or automatic rheostat behaves like the governor of a steam-engine. There are of course several obvious disadvantages in the use of such an instrument, but we cannot recall any other continuous self-acting "voltastat." Helmholtz, in order to keep the disc of his siren rotating at a constant rate, employed an electro-magnetic arrangement with attached governor, but here the current was interrupted when it exceeded a certain strength.

In the electro-chemical portion of this treatise students will find much information concerning the reactions within various forms of batteries and in the electrolysis of salts, and some interesting facts on electric osmose. The explanation Dr. Guthrie gives of the prevention of "local action" by amalgamation of the zinc is new to us. The chief cause of local action—which the author describes as "a coasting trade"—is attributed to difference of hardness rather than metallic impurities on the surface of the zinc; mercury, it is asserted, removes this inequality of hardness due to irregular cooling, "for as the mercury penetrates, the mass softens and molecular strains are relieved, and uniformity results" (p. 141).

And here we would note one or two minor experimental statements in the book which we think it would be an advantage to modify, as readers might unintentionally be misled. In speaking of the electrolysis of water the author states that in the first portions of the gas collected the hydrogen is less than its theoretical proportion. "This is due to the 'occlusion' of hydrogen by platinum under these circumstances. The hydrogen is absorbed by the platinum. Very soon, however, the metal becomes saturated, and the exact combining ratio is observed" (p. 157). This effect, we imagine, must very promptly be masked by a contrary action—to which Dr. Guthrie does not allude—for, except under special circumstances, the amount of *oxygen* is perceptibly deficient in electrolysis, and, as is well known, is due to the formation of ozone. And is not the following electro-chemical statement also open to comment?—"Hydrogen, when freshly liberated, has, as is well known, an exceedingly powerful reducing action. Use is made of this circumstance to protect the copper sheathing of ships, ... the evolution of hydrogen on the copper surface deoxidises any oxidised portion" (p. 128). A student might from this be led to infer that the electro-negative metal in a cell would not be protected unless hydrogen were evolved on its surface. Again, in describing the evolution of electricity by an ordinary electric machine, it is merely stated that "the + electricity enters the prime conductor, and − leaves it; the prime conductor thus becomes +" (p. 52). A reference to the inductive action exerted on the prime conductor, the high tension at the points, and therefrom the discharge of the induced opposite electricity on to the machine, seems needed here.

We must now devote a few words to one feature wherein the present text-book differs from most of the ordinary manuals on electricity. Dr. Guthrie has sought to give the reader some acquaintance with terms and methods of measurement which in general are better understood by the practical electrician than the science teacher. Whilst every such effort cannot fail to be more or less useful, the present is, we regret to notice, open to criticism in several directions. But as we have neither the space nor the inclination to notice all the points we have marked, one illustration will suffice. On pp. 225 and 226 we have the unit of resistance set forth as follows: "Taking 1 second as unit of time, 1 metre as unit of length,* and 1 gramme as unit of weight, an 'absolute' unit of resistance is obtained by employing the above equations [viz., Q (or current strength) $= \frac{fd^2}{lm}$ and W (or current work) $= Q^2 r t$], and this multiplied by one hundred million is the Ohm or B.A. unit." Here, irrespective of other considerations, there is the fundamental error of using the term *weight* instead of *mass*, and moreover, the student must fail to grasp the idea that electric resistance can be expressed as a velocity, and has nothing to do with either weight or mass. There is no hint of these considerations in the manual before us; the electrostatic system of units is not even referred to, nor is the student made aware of the precise nature of the units described.

This text-book is open to criticism also in some other portions which deal with more familiar questions. Notably, take for example a proof connected with Ohm's law, given on p. 185; or the paragraphs on linear resistance, § 243—247, which certainly will bewilder the reader unnecessarily, when a more general result can be deduced more easily and obviously in as many lines as pages are here devoted to the subject. Nor is it necessary for the particular proof, even if it were true, that the potential at the zinc end of the battery is = 0, as stated on p. 221.

In § 257, referring to the effect of heat on the resistance of liquid conductors, the fact is lost sight of that mercury (quoted as militating against a theory that is given) is not an electrolyte, and so has nothing in common with the generality of liquid conductors. On p. 224 the author shows how the diameter of fine wires may be deduced from their length and weight, and then adds: "The relative diameter of two wires can be deduced from their weights, lengths, and *resistances*;" here weight, no doubt, was meant to be omitted. There is also an earlier paragraph needing great amendment, viz. § 214, where electrical resistance is compared with the resistance experienced by water in flowing through pipes; but as any analogy there might be is destroyed by the definition adopted of water-resistance, it is, we think, a mistake to have introduced the elaborate and withal erroneous comparison that is given. And surely two woodcuts of the same tube on p. 179 were hardly necessary, as if turning the tube one way or the other could make any difference in the reasoning. In fact, the evident care everywhere taken by the author to make his meaning clear, has perhaps led him occasionally to the opposite extreme of unnecessarily laboured explanations, so that some really

* After the strong reasons which exist in favour of the C.G.S. system of units, it is to be hoped that the centimetre will become more generally used as the unit of length.

simple matters become invested with an air of great difficulty. Thus, to take one other example, we should have thought it needless to devote so much space to the difference between a right and left-handed spiral, as is given on p. 242, *et seq.*

There are also several clerical errors and misprints throughout the book, which we regret we have not space to point out, as they ought to be corrected in a new edition; some of the woodcuts, moreover, need alteration.

In conclusion, we must remark that, although a careful perusal of this work has led us to notice several things which ought to have been different, yet we are not insensible to the good features of this unpretending text-book, and we hope, therefore, that Dr. Guthrie will have a speedy opportunity of removing the blemishes which seriously mar the usefulness of his book. In the strictures we have ventured to offer we trust nothing offensive to the author has appeared, for whom we entertain, and are glad to be able to express, our sincere respect.

TWO AMATEUR EXPLORERS

"*The Great Divide.*" Travels in the Upper Yellowstone in the Summer of 1874. By the Earl of Dunraven. With Illustrations by V. W. Bromley. (London: Chatto and Windus, 1876.)

Yachting in the Arctic Seas; or, Notes of Five Voyages of Sport and Discovery in the neighbourhood of Spitzbergen and Novaya Zemlya. By James Lamont, F.G.S., F.R.G.S. Edited and Illustrated by W. Livesay, M.D. (Same publishers.)

THE number of works of travel published within the last few months is probably unprecedented. Scarcely a week has passed during that time in which we have not had occasion to notice one or more in these columns. One noteworthy feature about these narratives of travel is that few of them are by what may be called professional explorers, men who have led expeditions into unknown or little known lands and seas for the sole purpose of extending our knowledge of them. They are mostly written by men who, solely from a love of adventure and sport, have left all the comforts and luxuries which wealth and a high social position can bring to undergo many of the hardships and privations which fall to the lot of those who have adopted discovery as their work in life. No doubt improvements in modes of travel, and especially in steam navigation, have something to do with this, as has also the tedium which occasionally comes upon every intelligent man who has to plod the weary round of the duties, and especially the pleasures, of civilised life. But, as we said last week, we are inclined to attribute this growing love of travel, of amateur exploration, in some degree to the general advance of intelligence urging those who can afford it to gratify their craving for knowledge by stronger stimulants than can be obtained from books. Possibly also some may think this growing love of travel in wild regions, mingled as it often is with intense delight in dangerous sport, is to some extent a breaking out of remote ancestral habit, of a habit which still clings to us from a time when our ancestors, like existing savages, were explorers and hunters of the wildest animals for dear life—a habit which only requires a favourable opportunity to be re-developed, though with a different aim. Whatever may be the causes, there can be no doubt about the fact of the rapidly-growing love of adventure and discovery, involving dangers and hardships of a very real kind. No better examples could be found than those of the authors of the two works before us.

The scene of the Earl of Dunraven's wanderings is in and around that wonderful and interesting region of North America, on the borders of Montana and Wyoming, known as the Yellowstone Park, which the U.S. Government have had the wisdom to set aside as a "gigantic pleasuring ground." Anyone looking at a good map of the United States will perceive the appropriateness of the term "The Great Divide" as applied to the mountainous region in the neighbourhood of the Upper Yellowstone. It is indeed the geographical centre of North America; here the principal rivers of the United States take their rise and flow in all directions—north, south, east, and west. We have already (vol. vi., pp. 397, 437) given considerable details and several illustrations of this remarkable region of gigantic geysers, and boiling mud and sulphur springs, and not much has since been done to add to our knowledge of it. The Earl of Dunraven, during the few weeks he spent in the district with a few boon companions, made a pretty careful examination of some of the most remarkable phenomena, and the record of this, supplemented by copious extracts from the accounts of the U.S. exploring expeditions, will give the general reader a very fair idea of the characteristics of this strange region. The Earl reached the Upper Yellowstone region by travelling northwards from Corinne on the Great Salt Lake; and both on his journey northwards, during his hunting of the mountain-sheep or bighorn (*Caprovis Canadensis*), the wapiti, and other wild animals, and his exploration of the geyser and boiling spring region, he and his party occasionally endured considerable hardship, which, however, they all seemed thoroughly to enjoy as an essential part of the programme of the expedition. Considerable details are given as to the character and condition of the various tribes of Indians to be met with in the neighbourhood of the region traversed, and the Earl has much to say on the Indian question. We do not think, however, that our ignorance of the Indian, his habits and traditions, is so great as the Earl would make out to be the case. There really exists a vast amount of information concerning the aborigines of North America at least, and Mr. Bancroft is doing good service in collecting into one magnificent work all that is known of the natives of the Pacific States. Still there can be no doubt that the American Indians are rapidly dying out, and in the interests of science it would be well to use all diligence in supplementing the doubtless by no means complete information we at present possess. As to civilisation and conversion, the Earl of Dunraven has as bad an opinion of the Indian as Mr. Monteiro and Capt. Burton have of the nature of an African.

On the whole we may say that the Earl of Dunraven's work is a jolly rollicking narrative of adventure and sport, mixed up with a great deal of useful information concerning one of the most interesting regions in the American continent. The illustrations are interesting, and some of them help out considerably the descriptions in the text,